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(54) Roof-mounted multifunctional car antenna

(57) A multifunction antenna particularly suited for the roof panel of cars characterised by the fact that in the container (1) the following functions are comprised the radio reception function in AM and FM bands (10), the GPS (Global Positioning System) signal reception function (6) of reception/transmission of GSM (Global System for Mobile Communications)/DCS Dual Band (12) telephone signals and the mixing functions of various signals and of the required feedings on a unique coaxial connector (4); the multifunction antenna being interfaced to an ITN (Info-Telematic Node) system at the entry (20) of which a signal demixer (21) is placed, said signal demixer is interconnected to said coaxial connector (4) through a unique screened coaxial cable (19) through which all the mixed signals and the properly measured feedings are transmitted and/or received.

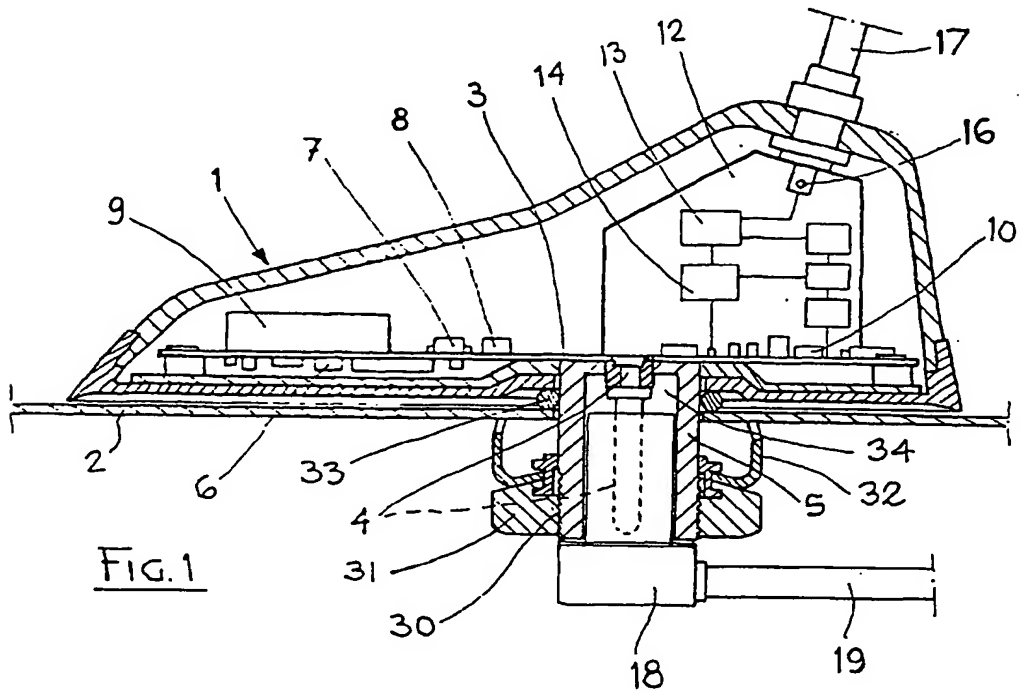

FIG. 1

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Description

[0001] The present invention refers to a multifunction antenna. More particularly, the present invention refers to a multifunction antenna which is generally suited to be installed on the roof panel of cars.

[0002] It is well known that the multifunction reception and transmission systems of radio and telephone signals which are presently adopted for the installation on cars are created according to various realizations. Some of them adopt separate and different antennas and connections for each function which cannot interfere among them in any way. In other realizations some functions are associated and, in this case, they require particular screening stratagems in order to avoid interferences among the same functions.

[0003] The realizations of the first type are the more reliable ones, but they are more easily installed only on luxury cars, where problems connected to the spaces required to place the systems and the production cost containment requirements are marginal.

[0004] In the most common and recent multifunction systems which are greatly installed on intermediate and small cars and where a particular attention must be paid on possible production cost savings and installation times of the systems, the antennas and their electronic circuits tend to be comprised in a unique container which can be applied on the roof panel of cars.

[0005] Said antennas are connected to the so-called "Info-Telematic Nodes" (ITN), placed in the dashboard which, in their simplest form, comprise separate entries for each function.

[0006] The most common and required realizations of multifunction systems are the ones comprising a reception antenna of the amplitude modulation (AM) and the frequency modulation (FM) radio signals together with its relevant feeding; a reception/transmission antenna of Dual Band telephony signals; a reception antenna of the GPS signals for navigation and a corresponding power supply.

[0007] These realizations are generally connected to the separate entries of the various functions which are placed on said ITNs through single and independent cables.

[0008] In more advanced applications the reception function of the AM and FM radio signals and the reception/transmission function of the Dual Band telephony signals are obtained by the same rod; while the reception of GPS navigation signals is obtained by a miniaturized patch antenna. Moreover, the feedings reach the amplification and matching circuits both for the AM/FM reception part and for the one receiving the GPS signals through the central wire of the respective output coaxial cables.

[0009] The research is substantially aimed at finding economical solutions being able to face the business competition aggressiveness. All the above mentioned solutions are conceived in order to reduce the number of applied cables, their extension and the related connections, simplify the coupling means of connections, reduce the costs of the single components and times related to application, installation and maintenance interventions, the labour and the costs in general considering the technological requirements of the systems which are due to correctly operate without interference problems among the various functions.

[0010] To this purpose, in some of the most recent configurations the reception/transmission of Dual Band telephony signals associated to the AM and FM radio signal reception antenna rod comprises a unique coaxial cable for the connection to the ITN system which also conveys the power supply to the relevant electronic circuits, while for the reception signals of the GPS navigation systems where the risk of interferences towards other functions is very high, the connection among the antenna, the ITN system itself and the relevant feeding requires a separate coaxial cable.

[0011] Object of the present invention is to overcome also this inconvenient. The invention as it is, characterised by the claims, solves the problem through a multifunction roof panel antenna for cars which is comprised in a unique container including: the radio reception function in AM and FM bands, the reception/transmission function of the GSM (Global System for Mobile Communications) Dual Band (900 an 1800 MHz bands) telephone signals, the reception function of the GPS (Global Positioning System) signal and a signal mixer of these functions; the latter interfacing with an ITN (Info-Telematic Node) equipped with a suitable demixer by a unique screened coaxial cable through which the signals of all the above mentioned functions and the required feedings are properly measured, transmitted and/or received .

[0012] The advantages obtained according to the present invention essentially consist in the fact that the container which can be applied to the roof panel of cars includes all the antennas with the relevant feeding, reception, reception/transmission electronic circuits which associate to a unique mixing circuit of the signals of the various functions. Said mixer depends on a unique quick coupling output connector for a unique coaxial cable to be connected to an ITN unit placed in the dashboard; the ITN unit is equipped with one entry connector for a demixer fit for the separation of the signals of the various functions.

[0013] Everything is configured in such a way to adopt only one coaxial cable having a limited extent to be reduced to one connection only among antennas and ITNs, in order to simplify the coupling means of connections and greatly reduce the costs related to single components, labour and installation times thus keeping the technical features of the systems operating without interferences among the various functions unchanged.

[0014] The invention is described in detail here below according to one embodiment which is exclusively given by way of illustrative but non-limitative example, with ref-

erence to the following drawings wherein:

Figure 1 represents the schematised longitudinal section of a roof panel container comprising: the various antennas, the relevant signal amplification and/or impedance matching electronic circuits, the signal mixing circuit, the feedings of the various functions and the unique connector for the output coaxial cable,

Figure 2 represents a non-limitative example of the scheme of the amplification electronic circuit of the AM-FM reception antenna,

Figure 3 represents a non-limitative example of the impedance matching and filtering electronic circuit for the Dual Band reception/transmission telephone antenna (900 MHz - GSM and 1800 MHz - DCS),

Figure 4 represents a non-limitative example of the scheme of the electronic circuit of the GPS navigation antenna,

Figure 5 represents the block diagram of the electronic circuits of the whole antenna and of the signal mixing circuit and,

Figure 6 represents the block diagram of the signal demixing electronic circuit which is placed at the entry of the ITN unit.

[0015] With reference to Figure 1, inside a container 1 which can be applied to the roof panel 2 of cars, a first horizontal board 3 is placed on which, from printed circuit, a coaxial connector 4 getting into constraint and contact relation with a fixing hub 5 is integral.

[0016] On the lower front part of the horizontal board 3 the low noise amplification (LNA) electronic circuit for GPS signals together with a narrow band band-pass filter 7 is obtained. On the upper front part of the same horizontal board 3 the "patch antenna" 9 related to the same electronic circuit 6 of the GPS function is placed. In the rear part of the horizontal board 3, the electronic circuit 10 of the AM/FM radio receiving functions with the low-pass filter 11 and the connection to a vertical board 12 on which the impedance matching circuit 13 with the matching high-pass filter 14 for the Dual Band (GSM/DCS) telephony reception/transmission function and the contact with the cap 16 of the antenna rod 17 which is common for both functions is placed.

[0017] In Figures 2,3 and 4 examples of various antenna circuits are represented: the circuit 10 for AM/FM radio reception which is placed on the rear part of the horizontal board 3; the circuit 13 for the reception/transmission of Dual Band telephony which is placed on the vertical board 12; the circuit 6 for the GPS navigation reception which is placed on the front part of the same horizontal board 3.

[0018] Figure 5 represents the whole block diagram of the above-mentioned circuits wherein the power supply point for the electronic circuit 10 of AM/FM radio reception is marked with the **"a"** symbol. Said reception is obtained by the block inductance **"c"** directly from the central wire of the unique output coaxial cable and it is connected to the GPS navigation electronic circuit 6 (in order to reduce the feeding voltage from 10-16 V to the required 3 or 5 V) through the voltage regulator 8.

[0019] In the block diagram represented in Figure 5, the multifunction rod 17 is connected to the impedance matching circuit 13 and subsequently to the high - pass filter 14 through the node 16. The multifunction rod itself is also connected to the two separate stages for the AM signal conditioning and the matching and/or the amplification of the FM signals. At their turn, the signals of the two stages sum up and pass through the low - pass filter 11. The receiving element for the signals of the GPS 9 (which is generally a patch antenna with a circular polarization) is connected to the low noise amplification electronic circuit 6 which, in its turn, is connected to the band - pass filter 7. The signals going out from the three filters 14, 11 and 7 gather together in 4 and, through the connector 18, they go to the unique coaxial cable 19 and to the signal demixing electronic circuit 21.

[0020] The current feeding for all the active circuits of the multifunction antenna which are present on the central wire of the coaxial cable 19 crosses the low - pass filter 11 and it is separated by the signal wires through the choke C and the balancing capacitor connected to it. From here, it directly feeds the AM and FM stages and also the low noise amplification electronic circuit 6 through the voltage regulator 8.

[0021] The **A** (870÷960 MHz); **B** (1710÷1880 MHz) GSM7DCS Dual Band telephony; **C** (1575± 5 MHz) GPS navigation system; **D** (0-110 MHz) AM/FM radio reception and the required feedings filtered antenna signals are conveyed and mixed on the unique coaxial connector 4 which is associated to the fixing hub 5 which, through its lower threaded part 30 coupled to a nut 31 with a grip elastic element 32 and a gasket 33, acts as a constraint element of the multifunction antenna to the roof panel 2, while with its hollow central part 34 it constitutes the guiding and contact element for the same connector 4. A complementary plug applied to one end of a short cable with pigtail connector to which a further coaxial cable connects can be engaged to the connector 4; a plug 18 for a unique specific coaxial cable 19 can be also engaged to the connector 4 for each type of car on which the multifunction antenna is applied. Such unique specific coaxial cable 19 develops for a sufficient and right length allowing the connection with the unique connector 20 of a signal demixing electronic circuit 21 placed at the entry of the Info-Telematic Node (ITN) which is housed in the dashboard. The demixer task is to separate the signals and prevent that interferences among them take place. It particularly prevents that the DCS signal at 1800 MHz go out with about 1 Watt of power from getting into the entry of the GPS receiver blocking it.

[0022] The main features of the signal demixer 21 essentially consist in the fact that: the insulation between DCS and GPS at 1700 MHz is comprised between 60

and 70 dB and is obtained by a filter on the GPS path of at least 50 dB and by a notch filter which is placed on the phone side producing an attenuation of at least 10 dB.

[0023] From the confluence node 29 of the mixed signals. signals **A** and/or **B** pass through a high-pass filter 22 and a stop filter 23 at 1575 MHz with an attenuation of at least 10 dB in order to reach the Dual Band telephony transceiver set included in the ITN Signals **C** pass through a band-pass filter 24 at 1575 MHz with A (attenuation) > 50 dB at 1700 MHz in order to be picked up by the radio receiving set included in the ITN.

[0024] In the schemes of Figures 2 and 3. XX and YY represent the interface points of the electronic circuit 10 of the AM/FM radio reception which is placed on the rear part of the horizontal board 3 and of the impedance matching circuit 13 of the Dual Band telephone transmission/reception which is placed on the vertical board 12 which are associated to the same antenna 17 In the scheme of Figure 2. the power supply point (of 10-16 V) of the electronic circuit 10 of the AM/FM radio reception is represented with **"a"**, while in the scheme of Figure 4, **"a"** represents the power supply point equipped with the relevant voltage regulator 8 of the low noise amplification electronic circuit 6 of GPS signals which is placed on the front part of the horizontal board 3 and it is associated to the "patch antenna" 9 In the schemes of Figures 2 and 4 **"b"** represents the interface point of the electronic circuits 6 and 10 towards the unique coaxial connector 4.

[0025] Even though the present invention has been described and illustrated here with reference to an embodiment which is given only by way of non-limitative example, it is clear that various changes and variants to forms, particulars. components and combinations can be made by people skilled in the art according to the above-mentioned description It is therefore clear that the present invention is meant to include all the changes and variants falling within the spirit and the protection field of the following claims.

Claims

1. A multifunction antenna particularly suited for the roof panel of cars **characterised by** the fact that in the container (1) the following functions are comprised: the radio reception function in AM and FM bands (10). the GPS (Global Positioning System) signal reception function (6) of reception/transmission of GSM (Global System for Mobile Communications)/DCS Dual Band (12) telephone signals and the mixing functions of various signals and of the required feedings on a unique coaxial connector (4); the multifunction antenna being interfaced to an ITN (Info-Telematic Node) system at the entry (20) of which a signal demixer (21) is placed said signal demixer is interconnected to said coaxial connector (4) through a unique screened coaxial cable (19) through which all the mixed signals and the properly measured feedings are transmitted and/or received.

2. The multifunction antenna according to claim 1, **characterized by** the fact that, inside the container (1) which can be applied to the roof panel (2) of cars, a first horizontal board (3) on which a coaxial connector (4), from printed circuit is integral in correspondence of a fixing hub (5) for a coaxial connector (19), is placed.

3. The multifunction antenna according to claim 1 or 2, **characterized by** the fact that on the lower front part of the horizontal board (3) a low noise amplification (LNA) electronic circuit (6) for GPS signals comprising a narrow-band band-pass filter (7) is obtained; on the upper front part of the same horizontal board (3) a "patch antenna" (9) related to the same electronic circuit (6) of said GPS function is placed.

4. The multifunction antenna according to any of the previous claims, **characterized by** the fact that in the rear part of the horizontal board (3) an electronic circuit (10) of the AM/FM radio reception functions with low-pass filter (11) is placed together with the connection with a vertical board (12) on which an impedance matching circuit (13) with low-pass matching filter (14) for Dual Band telephony reception/transmission function; on said vertical board (12) being placed the contact with the cap (16) of the antenna rod (17) which is common to both functions.

5. The multifunction antenna according to any of the previous claims, **characterized by** the fact that the **A** (870÷960 MHz); **B** (1710÷1880 MHz) GSM7DCS Dual Band telephony; **C** (1575± 5 MHz) GPS navigation system; **D** (0-110 MHz) AM/FM radio reception and the required feedings filtered antenna signals are conveyed and mixed on the unique coaxial connector (4).

6. The multifunction antenna according to any of the previous claims **characterized by** the fact that a complementary plug applied to one end of a short cable with pigtail connector to which a further specific coaxial cable (19) connects whose length is sufficient and right for each type of car on which the multifunction antenna is applied for the connection with the unique connector (20) of a signal demixing electronic circuit (21) placed at the entry of the Info-Telematic Node (ITN) housed in the dashboard can be engaged on the connector (4).

7. The multifunction antenna according to any of the

previous claims, **characterized by** the fact that it comprises a plug (18) for a unique specific coaxial cable (19) whose length is right and sufficient for each type of car on which the multifunction antenna is applied for the connection with the unique connector (20) of a signal demixing electronic circuit (21) placed at the entry of the Info-Telematic Node (ITN) housed in the dashboard.

8. The multifunction antenna according to any of the previous claims **characterized by** the fact that the demixer (21) comprises: a high-pass filter (22) and a stop filter at 1575 MHz (23) with an attenuation of at least 10 dB for the demixing of the **A** (870÷960 MHz) and/or the **B** (1710÷1880 MHz) ingoing/outgoing signals of the Dual Band telephony transceiver set comprised in the ITN; a band-pass filter (24) at 1575 MHz with A>50 dB at 1700 MHz, for the demixing of the **C** signals (1575± 5 MHz) of the GPS navigation system which can be detected from the GPS receiver set comprised in the ITN, a low-pass filter (25) for the demixing of the **D** (0-110 MHz) signals of the AM/FM radio reception which can be detected from the radio receiving set comprised in the ITN.

9. The multifunction antenna according to any of the previous claims, **characterized by** the fact that the insulation between DCS and GPS at 1700 MHz of the demixer (21) is comprised between 60 and 70 dB.

10. The multifunction antenna according to claim 9 **characterized by** the fact that the insulation between DCS and GPS is obtained by a filter placed on the GPS path of at least 50 dB and by a notch filter placed on the phone side producing an attenuation of at least 10 dB.

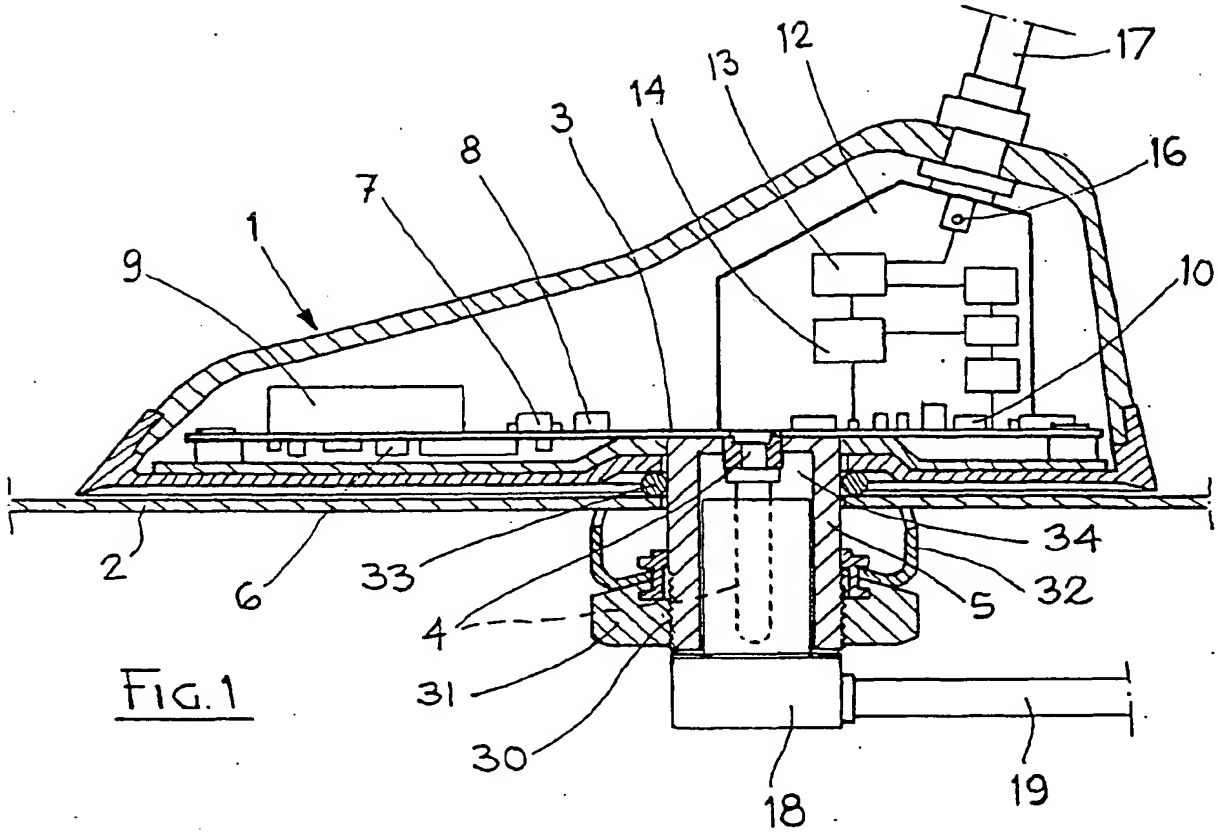
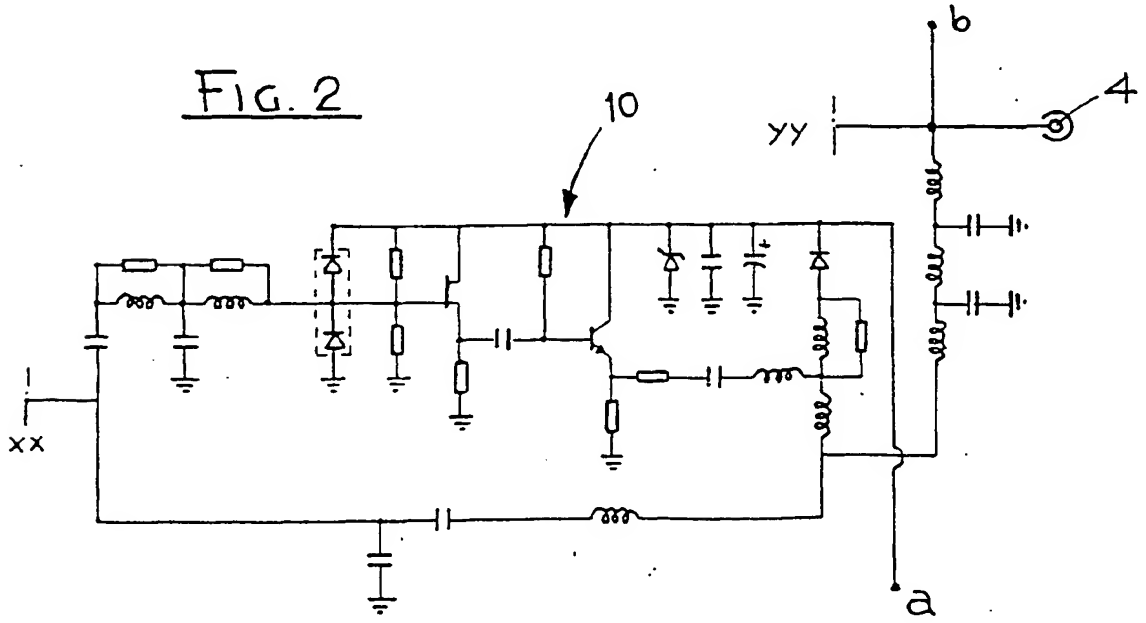


FIG. 1

FIG. 2



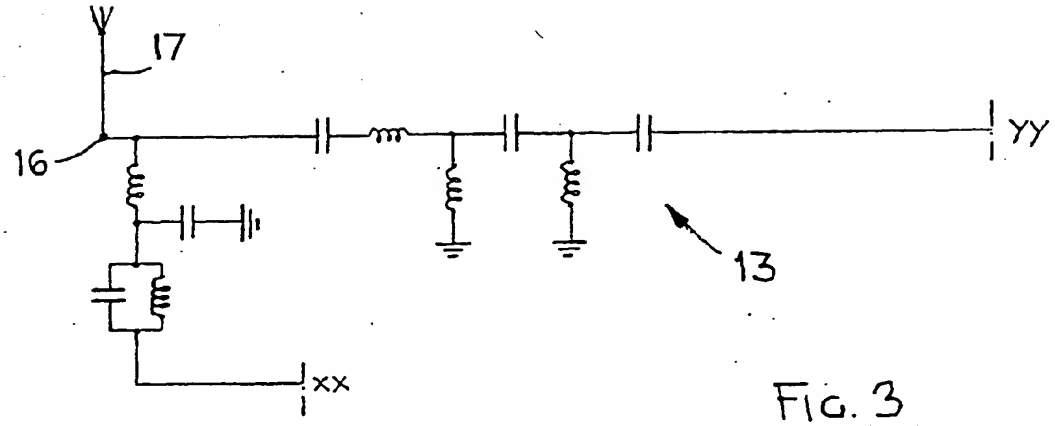


FIG. 3

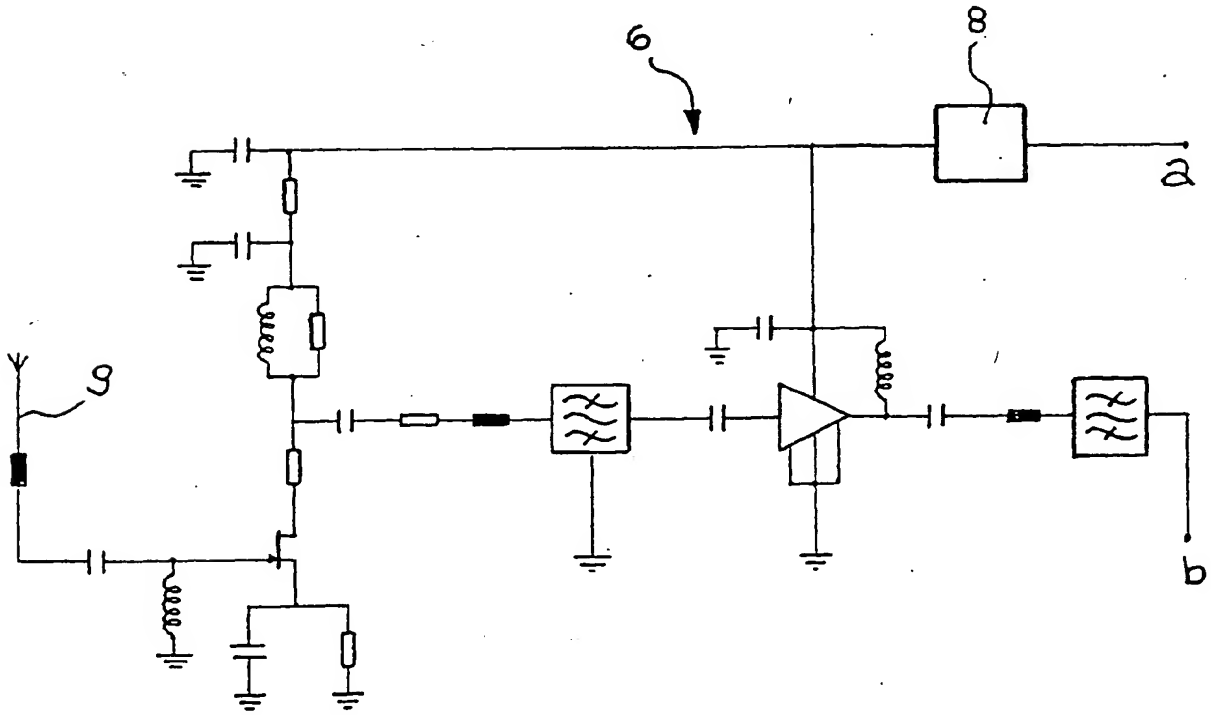
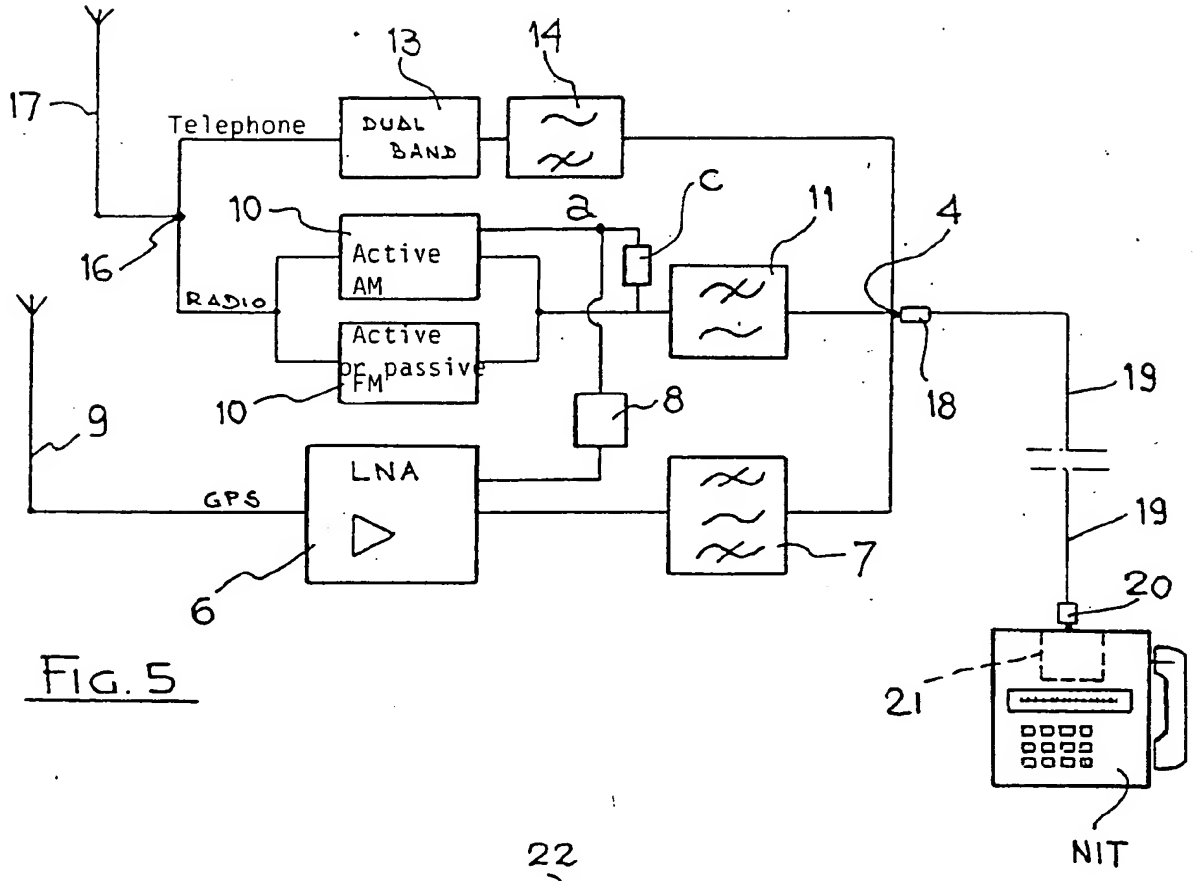


FIG. 4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RADIO
Active or passive FM
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GPS
LNA
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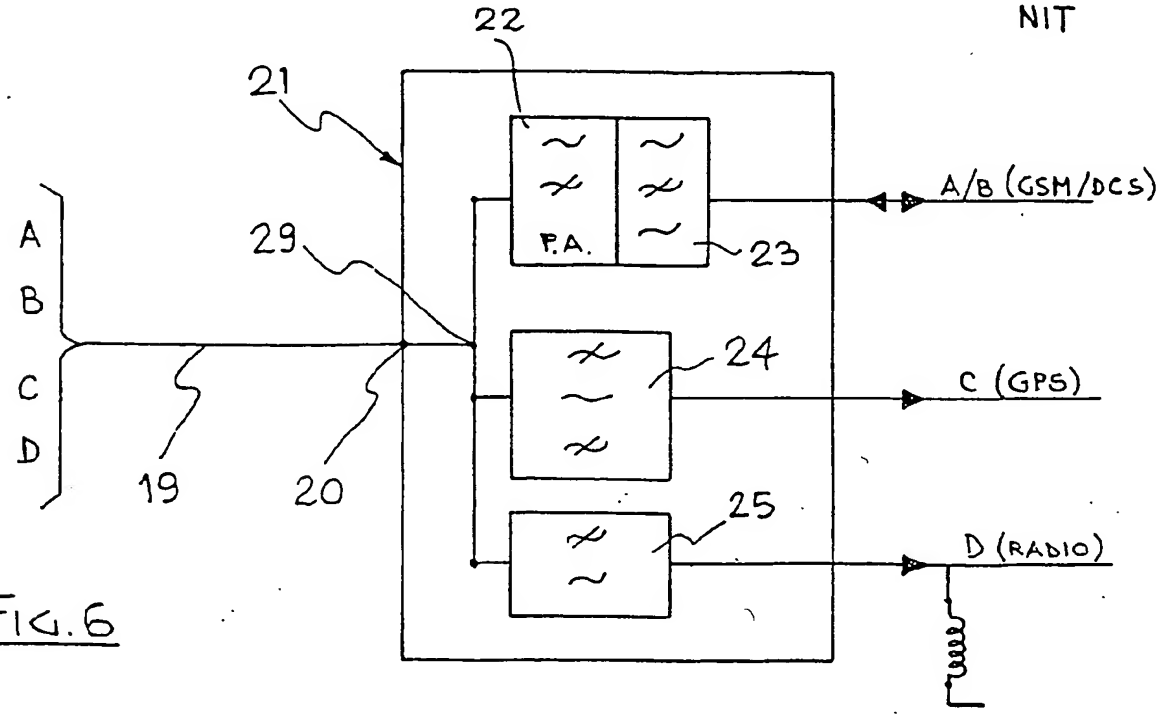
FIG. 5


22
21
A
B
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D
29
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P.A.
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A/B (GSM/DCS)
C (GPS)
D (RADIO)

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 805 113 A (OGINO TOSHIKAZU ET AL) 8 September 1998 (1998-09-08) * column 4-8; figures 1,2,5 *	1,2,5-10	H01Q1/32 H01Q21/28 H01Q25/00 H01Q1/12
A	WO 98 15075 A (BOSCH GMBH ROBERT ;VAHLE ANDREAS (DE); AUMAYER RICHARD (DE); BOCHM) 9 April 1998 (1998-04-09) * abstract; figure 1 * * page 5 *	1	
A	EP 0 747 993 A (HARADA IND CO LTD) 11 December 1996 (1996-12-11) * figure 2 *	2	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01Q
G01S

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 August 2002	Ribbe, J

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21-08-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5805113 A	08-09-1998	JP 8204442 A	09-08-1996
		JP 8213814 A	20-08-1996
WO 9815075 A	09-04-1998	DE 19640735 A1	23-04-1998
		WO 9815075 A2	09-04-1998
		EP 0929953 A2	21-07-1999
		JP 2001503513 T	13-03-2001
		US 6282491 B1	28-08-2001
EP 0747993 A	11-12-1996	JP 8335824 A	17-12-1996
		EP 0747993 A2	11-12-1996

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